General

Guideline Title

Capnography/capnometry during mechanical ventilation: 2011.

Bibliographic Source(s)

Walsh BK, Crotwell DN, Restrepo RD. Capnography/capnometry during mechanical ventilation: 2011. Respir Care. 2011 Apr;56(4):503-9. PubMed

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: McArthur CD. AARC clinical practice guideline. Capnography/capnometry during mechanical ventilation--2003 revision & update. Respir Care 2003 May;48(5):534-9.

Recommendations

Major Recommendations

The levels of evidence (A-D) and the strength of the recommendations (1-2) are defined at the end of the "Major Recommendations" field. The words "recommended" and "suggested" are used to reflect the strength of the recommendation, as level 1 and level 2, respectively.

Procedure

Capnography is the continuous analysis and recording of the carbon dioxide (CO_2) concentration in respiratory gas. Although the terms capnography and capnometry are sometimes considered synonymous, capnometry means only the measurement of CO_2 in respiratory gas (i.e., analysis alone), without a continuous written record or waveform. Capnographic waveforms may be time-based or volume-based (Hess & Branson, 1994).

Setting

Capnography can be performed by trained healthcare personnel in any setting in which mechanically ventilated patients are found.

Indications

There are 3 broad categories of indications for capnography/capnometry: verification of artificial airway placement; assessment of pulmonary circulation and respiratory status; and optimization of mechanical ventilation.

- Verification of Artificial Airway Placement. Even when the endotracheal tube is seen to pass through the vocal cords and tube position is

verified by chest expansion and auscultation during mechanical ventilation, providers should obtain additional confirmation of airway placement with waveform capnography or an exhaled CO_2 or esophageal detector device (Neumar et al., 2010).

- Exhaled CO_2 detectors, including colorimetric and non-waveform, reliably detect intratracheal placement in patients whose cardiac out-put is not exceedingly low or who have not had prolonged circulatory failure. Their use in prolonged cardiac arrest merits further study (Neumar et al., 2010; Goldberg et al., 1990).
    - When waveform capnography is not available, these methods can be used in addition to clinical assessment as the initial method for confirming correct tube placement in a patient in cardiac arrest.
- Capnography may be used as an adjunct to determine that tracheal rather than esophageal intubation has occurred (Hess & Branson, 1994; Wenzel et al., 2001; Rudraraju & Eisen, 2009).
- All intubations must be confirmed by some form of end-tidal CO_2 (P_{ETCO2}) measurement (Neumar et al., 2010; Field et al., 2010).
- Effective ventilation through a supraglottic airway device such as the laryngeal mask airway (LMA) should result in a capnograph waveform during cardiopulmonary resuscitation (CPR), and after return of spontaneous circulation (Neumar et al., 2010).
- When feasible, monitoring P_{ETCO2} during chest compressions is encouraged (Neumar et al., 2010).
    - If the P_{ETCO2} is <10 mm Hg during CPR, the clinician should attempt to improve the quality of compressions.
    - An abrupt and sustained increase in P_{ETCO2} is a sensitive indicator of return of spontaneous circulation.
- P_{ETCO2} monitoring is one of the objective standards required for monitoring patients in transport, to ensure integrity of the airway (Goldberg et al., 1990; Braman et al., 1987; Singh et al., 2006).
    - Providers should observe a consistent capnographic waveform with ventilation to confirm and monitor endotracheal tube placement in the field, in the transport vehicle, on arrival at the hospital, and after any patient transfer, to reduce the risk of unrecognized tube misplacement or displacement (Neumar et al., 2010; Silvestri et al., 2005).
- Capnography can be used to detect inadvertent airway intubation during gastric tube insertion (Howes, Shelley, & Pickett, 2005).
- Life-threatening airway disasters and ventilator disconnection can be averted with continuous capnography (Poirier et al., 1998; Ahrens & Sona, 2003; Joint Commission, 2002).

- Assessment of Pulmonary Circulation and Respiratory Status. Capnography assists in:
    - Determining changes in pulmonary circulation and respiratory status sooner than pulse oximetry. In patients without lung disease, substantial hypercarbia may present before pulse oximetry notifies the clinician of a change in ventilation (Poirier et al., 1998; Roberts & Maniscalco, 1995; Hall et al., 1993; Roberts et al., 1995; Shibutani et al., 1994).
    - Monitoring the adequacy of pulmonary, systemic, and coronary blood flow (Shibutani et al., 1994; Levine, Wayne, & Miller, 1997), as well as estimation of the effective (non-shunted) pulmonary capillary blood flow by a partial rebreathing method (de Abreu et al., 2002; de Abreu et al., 1997; vanHeerden et al., 2000).
    - Evaluating the partial pressure of exhaled CO_2, especially P_{ETCO2}.
    - Screening for pulmonary embolism (Rodger & Wells 2001; Rodger et al., 2001; Bolyard et al., 1998; Rumpf, Krizmaric, & Grmec, 2009).
- Optimization of Mechanical Ventilation. Capnography during mechanical ventilation allows:
    - Continuous monitoring of the integrity of the ventilator circuit, including the artificial airway (Spahr-Schopfer, Bissonnette, & Hartley, 1993) or bag mask ventilation, in addition to potentially detecting mechanical ventilation malfunctions (Muniz, 2008; Hardman, Mahajan, & Curran, 1999; Kumar et al., 1992)
    - Decreasing the duration of ventilatory support (Cheifetz & Myers, 2007)
    - Adjustment of the trigger sensitivity (Thompson & Jaffè, 2005)
    - Evaluation of the efficiency of mechanical ventilation, by the difference between P_{aCO2} and the P_{ETCO2} (Kerr et al., 1996)
    - Monitoring of the severity of pulmonary disease (Bedforth & Hardman, 1999; Ghamra & Arroliga, 2005) and evaluating the response to therapy, especially therapies intended to improve the ratio of dead space to tidal volume (V_D/V_T) and ventilation-perfusion matching (V/Q) (de Abreu et al., 1997; Bolyard et al., 1998; Engoren, 1993; Hardman & Aitkenhead, 1999; Hubble et al., 2000; Jellinek et al., 1993; Kallet et al., 2005; Russell & Graybeal, 1994; Szaflarski & Cohen, 1991; Taskar et al., 1995; McSwain et al., 2010).
    - Monitoring of V/Q during independent lung ventilation (Cinnella et al., 2001; Colman & Krauss, 1999).
    - Monitoring of inspired CO_2 when it is being therapeutically administered (Fatigante et al., 1994).
    - Graphic evaluation of the ventilator-patient interface. Evaluation of the capnogram may be useful in detecting rebreathing of CO_2, obstructive pulmonary disease, the presence of inspiratory effort during neuromuscular blockade (curare cleft), cardiogenic oscillations, esophageal intubation, and cardiac arrest (Bhavani-Shankar et al., 1992).
    - Measurement of the volume of CO_2 elimination to assess metabolic rate and/or alveolar ventilation (Russell & Graybeal, 1994;

Brandi et al., "Effects of ventilator resetting," 1999; Brandi et al., "Energy expenditure," 1999; Sullivan, Kissoon, & Goodwin, 2005)
- Monitoring of V_D/V_T to determine eligibility for extubation in children (Hubble et al., 2000; Wratney & Cheifetz, 2006)
- There is a relationship between V_D/V_T and survival in patients with the acute respiratory distress syndrome (Nuckton et al., 2002; Lucangelo et al., 2008; Raurich et al., 2010).

Contraindications

There are no absolute contraindications to capnography in mechanically ventilated patients, provided that the data obtained are evaluated with consideration given to the patient's clinical condition.

Hazards/Complications

Capnography with a clinically approved device is a safe, noninvasive test, associated with few hazards in most populations. Hazards/complications are different for the 2 types of capnographic device.

- Mainstream
  - Dead Space. Adapters inserted into the airway between the airway and the ventilator circuit should have a minimal amount of dead space. This effect is inversely proportional to the size of the patient being monitored (Szaflarski & Cohen, 1991; Jacobus, 2009).
  - The addition of the weight of a mainstream adapter can increase the risk of accidental extubation in neonates and small children (Jacobus, 2009).
- Sidestream
  - The gas sampling rate from some sidestream analyzers may be high enough to cause autotriggering when flow-triggering of mechanical breath is used. This effect is also inversely proportional to the size of the patient (Jacobus, 2009).
  - The gas sampling rate can diminish delivered tidal volume (V_T) in neonates and small patients while using volume targeted or volume controlled ventilation modes (Jacobus, 2009).

Limitations of Procedure or Device

Capnography, when performed using a device calibrated and operated as recommended by the manufacturer, has few limitations. It is important to note that although the capnograph provides valuable information about the efficiency of ventilation (as well as perfusion), it is not a replacement or substitute for assessing the P_{aCO2} (Hess & Branson, 1994; Jellinek et al., 1993; Hess, 1998; Isert, 1994; Laffon et al., 1998). The difference between P_{ETCO2} and P_{aCO2} increases as dead-space volume increases. (Russell & Graybeal, 1992). In fact, the difference between the P_{aCO2} and P_{ETCO2}varies in the same patient over time (Russell & Graybeal, 1994, 1995; Seguin et al., 2001; Grenier et al., 1999). Alterations in breathing pattern and V_T may introduce error into measurements designed to be made during stable, steady-state conditions. (Brandi et al., "Effects of ventilator resetting," 1999; Brandi et al., "Energy expenditure," 1999; Gamma de Abreu, Melo, & Giannella-Neto, 2000). Interpretation of results must take into account the stability of physiologic variables such as minute ventilation, V_T, cardiac output, V/Q, and CO_2 body stores. Certain situations may affect the reliability of the capnogram. The extent to which the reliability is affected varies somewhat among types of devices. Limitations include:

- The composition of the respiratory gas may affect the capnogram (depending on the measurement technology incorporated).
  - The infrared spectrum of CO_2 has some similarities to the spectra of both oxygen and nitrous oxide (Bhavani-Shankar et al., 1992). A high concentration of either oxygen or nitrous oxide, or both, may affect the capnogram, so a correction factor should be incorporated into the calibration of any capnograph used in such a setting (Hess, 1998).
  - The reporting algorithm of some devices (primarily mass spectrometers) assumes that the only gases present in the sample are those that the device is capable of measuring. When a gas that cannot be detected by the mass spectrometer (such as helium) is present, the reported CO_2 values are incorrectly elevated in proportion to the concentration of the gas present (Hess & Branson, 1994; Graybeal, 1994).
- The breathing frequency may affect the capnograph. A high breathing frequency may exceed the capnograph's response capabilities. The presence of high airway resistance, respiratory rate, or inspiratory-to-expiratory ratio may decrease the accuracy of the measurement obtained from a sidestream capnograph, compared to a mainstream capnograph (McEvedy et al., 1990; Tingay, Stewart, & Morley, 2005). In addition, a breathing frequency >10 breaths/min affects different capnographs differently (Graybeal, 1994).
- Contamination of the monitor or sampling system by secretions or condensate, a sample tube of excessive length, too high a sampling rate, or obstruction of the sampling chamber can lead to unreliable results.
- Use of filters between the patient airway and the capnograph's sampling line may lead to artificially low P_{ETCO2} readings (Hardman, Mahajan, & Curran, 1999; Hardman, Curran, & Mahajan, 1997).

- The sensitivity for confirmation of endotracheal intubation by color change could range from 67% to 72% (Keller et al., 2009).
- Clinical conditions associated with false negative readings include:
  - Low cardiac output may cause a false negative result when attempting to verify endotracheal tube (ETT) position in the trachea (Li, 2001).
  - During CPR a positive test confirms placement of the ETT within the airway, whereas a negative test indicates either esophageal intubation or airway intubation with poor or absent pulmonary blood flow and requires an alternate means of confirmation of tube position (American Heart Association [AHA], 2005; "The International Liaison Committee on Resuscitation [ILCOR]," 2006; American College of Emergency Physicians [ACEP], 2002).
  - When the endotracheal tube is in the pharynx and when antacids and/or carbonated liquids are present in the stomach, a false negative reading may be present. However, the waveform does not continue during subsequent breaths (Sum Ping, Mehta, & Symreng, 1992).
  - Elimination and detection of CO_2 can be dramatically reduced in patients with severe airway obstruction and pulmonary edema (Ward & Yealy, 1998).
- Clinical conditions associated with false positive readings include:
  - Colorimetric CO_2 detectors may give a false positive if contaminated with acidic or CO_2-filled gastric content, intratracheal medications such as epinephrine, extreme humidity, or the presence of trichloroethylene or chloroform anesthetics. Most require at least 6 breaths before a decision can be made (Goldberg et al., 1990; Kamlin et al., 2005).
  - Detection of CO_2 in expired gas after esophageal intubation as a result of prior bystander mouth-to-mouth ventilation may result in a false positive reading (Kramer-Johansen, Dorph, & Steen, 2008).
  - A transient rise in P_{ETCO2} after sodium bi-carbonate administration is expected, but should not be misinterpreted as an improvement in quality of CPR or a sign of return of spontaneous circulation (Neumar et al., 2010).
- Inaccurate measurement of expired CO_2 may be caused by leaks or other clinical circumstances preventing collection of expired gases (Kallet, 2008), including:
  - Leaks in the ventilator circuit
  - Leaks around the tracheal tube cuff, an uncuffed tube, or the mask, including LMA
  - Bronchopleural fistula
  - Dialysis or extracorporeal life support

Assessment of Need

Capnography is considered a standard of care during general anesthesia. The American Society of Anesthesiologists has suggested that capnography be available for patients with acute ventilatory failure on mechanical ventilatory support (American Society of Anesthesiologists [ASA], 2011). The American College of Emergency Physicians recommends capnography as an adjunctive method to ensure proper endotracheal tube position (ACEP, 2002). The 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care recommend capnography to verify endotracheal tube placement in all age groups (Goldberg et al., 1990). Assessment of the need to use capnography with a specific patient should be guided by the clinical situation. The patient's primary cause of respiratory failure and the severity of his or her condition should be considered.

Assessment of Outcomes

Results should reflect the patient's condition and should validate the basis for ordering the monitoring. Documentation of results (along with all ventilatory and hemodynamic variables available), therapeutic interventions, and/or clinical decisions made based on the capnogram should be included in the patient's chart.

Resources

- Equipment: the capnograph and accessories (e.g., airway adapter, sampling tube, depending on capnograph). The capnograph should be calibrated as recommended by the manufacturer.
- Personnel: licensed or credentialed respiratory therapists or individuals with similar credentials (e.g., medical doctor [MD], registered nurse [RN]) who have the necessary training and demonstrated skills to correctly calibrate and evaluate the capnograph, assess the patient and the patient-ventilator system, and the ability to exercise appropriate clinical judgment.

Monitoring

- During capnography the following should be considered and monitored:
  - Ventilatory variables: V_T, respiratory rate, positive end expiratory pressure (PEEP), ratio of inspiratory-to-expiratory time, peak

airway pressure, and concentrations of respiratory gas mixture (Garey et al., 2008; Engoren, 1993; Szaflarski & Cohen, 1991; Li, 2001; Gentile & Cheifetz, 2004).
- Hemodynamic variables: systemic and pulmonary blood pressure, cardiac output, shunt, and V/Q imbalances (de Abreu et al., 1997; Jellinek et al., 1993; Gamma de Abreu, Melo, & Giannella-Neto, 2000).

Frequency

Capnography (or, at least, capnometry) should be available during endotracheal intubation (Poirier et al., 1998; Roberts et al., 1995; Sum Ping, Mehta, & Symreng, 1991). Capnography is not indicated for every mechanically ventilated patient; however, when it is used, the measurement period should be long enough to allow determination of the P_{aCO2}-P_{ETCO2} difference, to note changes in the P_{aCO2}-P_{ETCO2} difference as a result of therapy, and to allow interpretation of observed trends.

Infection Control

No specific precautions are necessary, although standard precautions (as described by the Centers for Disease Control and Prevention) (Bolyard et al., 1998) and precautions designed to limit the spread of tuberculosis (Kallet, 2008; Jensen et al., 2005) should always be implemented during patient care.

- Reusable mainstream sensors should be subjected to high-level disinfection between patients, according to the manufacturer's recommendations.
- The external surface of the monitor should be cleaned as needed, according to manufacturer's recommendations.

Recommendations

The following recommendations are given based on the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) scoring system (Guyatt et al., 2008; Jaeschke et al., 2008):

- Continuous waveform capnography is recommended in addition to clinical assessment as the most reliable method of confirming and monitoring correct placement of an endotracheal tube (1A).
- If waveform capnography is not available, a non-waveform exhaled CO_2 monitor in addition to clinical assessment is suggested as the initial method for confirming correct tube placement in a patient in cardiac arrest (2B).
- P_{ETCO2} is suggested as a method to guide ventilator management (2B).
- Continuous capnometry during transport of a mechanically ventilated patient is suggested (2B).
- Capnography is suggested to identify abnormalities of exhaled air flow (2B).
- Volumetric capnography is suggested to assess CO_2 elimination and V_D/V_T to optimize mechanical ventilation (2B).
- Quantitative waveform capnography is suggested in intubated patients to monitor CPR quality, optimize chest compressions, and detect return of spontaneous circulation during chest compressions or when rhythm check reveals an organized rhythm (2C).

Definitions:

Strength of the Recommendations and Grade of Quality of the Evidence

Strength of the Recommendations		
Level	Strength	Description
1	Stronger	Benefits clearly outweigh the risks and burdens (or vice versa) for nearly all patients.
2	Weaker	Risks and benefits are more closely balanced or are more uncertain.
Quality of the Evidence		
Grade	Quality	Description
A	High	Well-performed randomized controlled trials or overwhelming evidence of some other sort. Further research is very unlikely to change confidence in the estimate of the effect.
B	Moderate	Randomized controlled trials that are less consistent, have flaws, or are indirect in some way to the issue being graded, or very strong evidence of some other sort. Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.

C	Low	Observational evidence (from observational studies, case series, or clinical experience), or evidence from controlled trials with serious flaws. Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
D	Very Low	Any estimate of effect is very uncertain.

Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650):924-926.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Any pulmonary disease or condition requiring mechanical ventilation

Note: Refer to the "Indications" section in the "Major Recommendations" field of this summary for specific conditions.

Guideline Category

Evaluation

Management

Prevention

Clinical Specialty

Anesthesiology

Critical Care

Emergency Medicine

Internal Medicine

Pediatrics

Pulmonary Medicine

Intended Users

Advanced Practice Nurses

Nurses

Physician Assistants

Physicians

Respiratory Care Practitioners

Guideline Objective(s)

To provide clinical practice guidelines on capnography/capnometry during mechanical ventilation

Target Population

Adult and pediatric patients receiving mechanical ventilatory support

Interventions and Practices Considered

1. Assessment of need for capnography/capnometry
2. Assessment of outcome
3. Resources (equipment and personnel) required
4. Monitoring of ventilatory and hemodynamic variables
5. Frequency of capnography
6. Infection control

Major Outcomes Considered

Accuracy, reliability, and utility of capnography/capnometry during mechanical ventilation

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

The guideline authors searched MEDLINE, CINAHL, and Cochrane Library databases for articles published between January 1990 and November 2010.

Number of Source Documents

The update of this clinical practice guideline is based on 234 clinical studies and systematic reviews, 19 review articles that investigated capnography/capnometry during mechanical ventilation, and the 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Grade of Quality of the Evidence

Grade	Quality	Description
A	High	Well-performed randomized controlled trials or overwhelming evidence of some other sort. Further research is very

Grade	Quality	Description
		unlikely to change confidence in the estimate of the effect.
B	Moderate	Randomized controlled trials that are less consistent, have flaws, or are indirect in some way to the issue being graded, or very strong evidence of some other sort. Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
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Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650):924-926.

Methods Used to Analyze the Evidence

Systematic Review

Description of the Methods Used to Analyze the Evidence

The American Association for Respiratory Care (AARC) clinical practice guidelines (CPGs) steering committee has initiated a new process by which the "reference-based" guidelines will be revised and updated by adopting a modification of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) scoring system (see the "Availability of Companion Documents" field). This guideline is the product of this process. Although it is clear that most treatments and interventions in respiratory care are rarely graded A, it is our responsibility to make recommendations based on the best evidence available at the time the CPG is updated. The words "recommended" and "suggested" are used to reflect the strength of the recommendation, as level 1 and level 2, respectively (see the "Rating Scheme for the Strength of the Recommendations" field). Although grading evidence is complex, the committee has set the goal of recommending what you, the clinician, should do. While the format for most traditional sections of the CPGs remains unchanged, each newly revised CPG includes recommendations with graded evidence. This is the latest in our efforts to improve the value of the AARC CPGs.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The recommendations are made following the Grading of Recommendations Assessment, Development and Evaluation (GRADE) scoring system.

Rating Scheme for the Strength of the Recommendations

Strength of the Recommendations

Level	Strength	Description
1	Stronger	Benefits clearly outweigh the risks and burdens (or vice versa) for nearly all patients.
2	Weaker	Risks and benefits are more closely balanced or are more uncertain.

Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650):924-926.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

References Supporting the Recommendations

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for selected recommendations (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate utilization of capnography during mechanical ventilation

Potential Harms

Certain situations may affect the reliability of the capnogram. The extent to which the reliability is affected varies somewhat among types of devices. Refer to "Limitations of Procedure or Device" in the "Major Recommendations" field.

Capnography with a clinically approved device is a safe, noninvasive test, associated with few hazards in most populations. Hazards/complications are different for the 2 types of capnographic devices.

Mainstream

- Adapters inserted into the airway between the airway and the ventilator circuit should have a minimal amount of dead space. This effect is inversely proportional to the size of the patient being monitored.
- The addition of the weight of a mainstream adapter can increase the risk of accidental extubation in neonates and small children.

Sidestream

- The gas sampling rate from some sidestream analyzers may be high enough to cause autotriggering when flow-triggering of mechanical breath sis used. This effect is also inversely proportional to the size of the patient.
- The gas sampling rate can diminish delivered tidal volume ($V_{T)}$ in neonates and small patients while using volume targeted or volume controlled ventilation modes.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Safety

Identifying Information and Availability

Bibliographic Source(s)

Walsh BK, Crotwell DN, Restrepo RD. Capnography/capnometry during mechanical ventilation: 2011. Respir Care. 2011 Apr;56(4):503-9. PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

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Financial Disclosures/Conflicts of Interest

Dr Restrepo is a consultant and researcher for Oridion, which manufactures capnographs. Mr Walsh and Mr Crotwell have disclosed no conflicts of interest.

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: McArthur CD. AARC clinical practice guideline. Capnography/capnometry during mechanical ventilation--2003 revision & update. Respir Care 2003 May;48(5):534-9.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the American Association for Respiratory Care (AARC) Web site .

Print copies: Available from AARC, 9425 N. MacArthur Blvd., Ste. 100, Irving, TX 75063.

Availability of Companion Documents

The following is available:

- Restrepo RD. American Association for Respiratory Care (AARC) clinical practice guidelines: from "reference-based" to "evidence-based." Respir Care. 2010 Jun;55(6):787-9. Available in Portable Document Format (PDF) from the American Association for Respiratory Care (AARC) Web site .

Print copies: Available from AARC, 9425 N. MacArthur Blvd., Ste. 100, Irving, TX 75063.

Patient Resources

None available

NGC Status

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